

M. Sc. Zoology 2015-2016 Onwards
Department of Higher Education, Govt. of M.P.
Semester wise Syllabus for Postgraduates

As recommended by Central board of Studies and
Approved by HE the Governor of M.P.

M.Sc. Zoology
First –Semester
Paper-1
Biosystematics, Taxonomy and Evolution

Unit I

I- . Definition and basic concepts of biosystematics taxonomy and classification.

- a..History of Classification
- b.Theories of biological classification:
- c.Trends in biosystematics:
 - (i)Chemotaxonomy
 - (ii)Cytotaxonomy
 - (iii)Molecular taxonomy,
 - (iv)Numerical taxonomy

II- Dimensions of speciation.

- a Species concepts : species category, Subspecies and other infra-specific categories.
Phylogenetic and biological concept of species.
- b Origin of reproductive isolation, Patterns and mechanism of reproductive isolation, biological mechanism of genetic incompatibility.
- c Modes of speciation (allopatry & sympatry -parapatric, peripatric)

Unit II

- Taxonomic procedures: Taxonomic collections, preservation, curation, process of identification and cataloguing.
- Hierarchy of categories : Taxonomic keys, different types of keys, their merits and demerits. Higher taxa.
- International code of Zoological Nomenclature (ICZN):
- Operative principles, interpretation and application of important
- rules: Formation of Scientific names of various Taxa.

Unit III

- I. Geological time scale –detail study
- II. Zoogeographical distribution of animals –
 - (a)Arctogeian Realm
 - (b)Neogeian Realm:
 - (c)Notogeian Realm
 - (d)Zoogeography of Indian Sub-region,
 - (e)Wallace's line and Weber's Line
- III. Study of Insular fauna

Unit IV

- Concepts of Evolution and Theories of Organic Evolution.
Neo Darwinism and population genetics:
A- Hardy-Weinberg law of genetic equilibrium.
B . A detailed account of destabilizing forces:
i- Natural selection
ii- Mutation
iii- Genetic Drift
iv- Migration
v- Meiotic Drive.

Unit V

- Phylogenetic, gradualism and punctuated equilibrium.
 - Molecular population genetics
 - Pattern of changes in nucleotide and amino acid sequence.
 - Ecological significance of molecular variations (genetic polymorphism) Trends in Evolution
- Molecular Evolution
- a) Gene evolution
 - b) Evolution of gene families
 - c) Assessment of molecular variation
- Origin and Evolution of primates

Suggested Reading Materials:

1. M. Koto-The. Biology of biodiversity-Springer
2. E.O. Wilson-Biodiversity-Academic Press Washington.
3. G.G.-Simpson-Principle of animal taxonomy Oxford IBH Publication company.
4. E-Mayer-Elements of Taxonomy
5. Bastchelet-F-Introduction to mathematics for life scientists Springer Verlag, Berling.
6. Skoal R.R. and F.J.Rohiff Biometry-Freeman, San-Francisco.
7. Snecdor, G.W. and W.G. Cocharan Statisical Methods of affiliated-East-West Press, New Delhi.
8. Murry J.D. Mathematical Biology-Springer, Verlag, Berlin.

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**M.Sc. Zoology
First semester
Paper –II**

STRUCTURE AND FUNCTION OF INVERTEBRATES

UNIT I

- Origin of metazoan, **Systematic Classification of Non Chordata**
- Organization of Coelom
 - o Acoelomates
 - o Pseudo coelomates
 - o Coelomates
- Locomotion.
 - o Amoeboid, Flageller and Ciliary movement in protozoa
 - o Hydrostatic movements in Coelenterata, Annelida and Echinodermata

UNIT II

- Nutrition and Digestion
- Patterns of Feeding and digestion in lower metazoa, Mollusca, Echinodermata, Filter feeding in polychaeta.
- Respiration
- Organs of Respiration : Gills, lungs and trachea.
- Respiratory pigments.
- Mechanism of respiration.

UNIT III

- Excretion in lower invertebrates (Contractile vacuole, Protonephridia/ flame cells)
- Excretion in higher invertebrates (Nephromixia, metanephridia/coxal glands/organ of bojanus)
- Mechanism of Osmoregulation (wsr to fresh water protozoa)

UNIT IV

Nervous System

- a. Primitive Nervous systems:-Coelentrata and Echinodermata.
- b. Advanced Nervous system :- Annelida, Arthropod (Crustacea and Insecta) and Mollusca (Cephalopoda)

UNIT V

1. Invertebrate larval forms and their evolutionary significance
 - a. Trematoda and Cestoda
 - b. Larval forms of Crustacea
 - c. Larval forms of Mollusca
 - d. Larval forms of Echinodermata.
2. Structure affinities and life history of the following minor Phyla
 - a. Rotifera
 - b. Entoprocta
 - c. Phoronida
 - d. Ectoprocta

Suggested Reading Materials:

1. Hyman, L.H. The invertebrates, Nol. I. protozoa through Ctenophora, McGraw Hill Co., New York
2. Barrington, E.J.W. Invertebrate structure and function. Thomas Nelson and Sons Ltd., London.
3. Jagerstein, G. Evolution of Metazoan life cycle, Academic Press, New York & London.
4. Hyman, L.H. The Invertebrates. Vol. 2. McGraw Hill Co., New York.
5. Hyman, L.H. The Invertebrates. Vol. 8. McGraw Hill Co., New York and London.
6. Barnes, R.D. Invertebrates Zoology, III edition. W.B. Saunders Co. Philadelphia.
7. Russel-Hunter, W.D. A biology of higher invertebrates, the Macmillan Co. Ltd., London.
8. Hyman, L.H. The Invertebrates smaller coelomate groups, Vol. V. McGraw Hill Co., New York.
9. Read, C.P. Animal Parasitism. Parasitism. prentice Hall Inc., New Jersey.
10. Sedgwick, A.A. Student text book of Zoology. Vol. I,II and III. Central Book Depot, Allahabad.
11. Parker, T.J., Haswell W.A. Text book of Zoology, Macmillan Co., London.

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M.Sc. Zoology
First semester
Paper-III

Quantitative biology, Biodiversity and Wildlife

Unit I

- Distribution of the data in biology- mean, mode and median
- Measures of dispersion: range, mean deviation, IQD, standard deviation and coefficient of variation
- Chi square test
- Normal distribution
- Experimental designing and sample theory

Unit II

- Probability distribution, properties and probability theory
- Completely randomized design and randomized block design
- Analysis of variance
- Co-relation- types of correlation
- Karl Pearson, coefficient correlation
- Regression

Unit III

Biodiversity

- Concept and principal of biodiversity
- Causes for the loss of biodiversity
- **Current status and future of biodiversity**
- Biodiversity conservation methods
- **Evaluation of biodiversity indices.**
- **Evaluation of Shannon - Weiner Index.**
- **Evaluation of Dominance Index.**
- **Similarity and Dissimilarity Index.**

Unit IV

Wildlife of India, types of wildlife

- Values of wildlife, positive and negative
- Wildlife protection Act **with latest amendments**
- Conservation of wildlife in India
- Endangered and threatened species
- Medicinal use of forest plants

Unit V

Wildlife and conservation

- National Parks and Sanctuaries ,
- Project Tiger
- Project Gir Lion and Crocodile breeding project
- Wildlife in M.P. with references to Reptiles Birds and mammals
- Biospheres reserves

Suggested Reading Materials:

- Bataschelet. E. Introduction to mathematics for site scientist springer-verlag, berlin
- Jorgenserr, S.E. Fundamental of Ecological modeling E. sevier New York
- Lenderen D. Modelling in behavioral ecology. Chapman & Hall London U.K.
- Sokal, R.R. and F. J. Rohit Biometry Freeman San Francisco
- Snedecor, G.W. and W.G. Cochran, statistical methods, Affiliated East, West Press New Delhi (Indian ed.)
- Muray , J.D. Mathematical Biology, Springer Verlag Berlin
- Pelon, E.C. The interpretation of ecological data : A primer on classification and ordination.
- A. Lewis . Biostatistics
- B.K. Mahajan Methods in Biostatistics
- V.B. Saharia wildlife in India
- S.K. Tiwari wildlife in central India
- J.D. Murrey Mathematical Biology
- Georgrs & Wilians Startical method
- R.K. Tondon Biodiversity Taxonomy & Ecology
- M.P. Arora An Introduction to Prevalentology
- P.C. Kotwal Biodiversity and conservation

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M.Sc. Zoology
First Semester
Paper IV

BIOMOLECULES AND STRUCTURAL BIOLOGY

Unit I

Chemical Foundation of biology

- PH, PK, acids bases, buffers, weak bonds
- Free energy, resonance, isomerisation
- Acid soluble pool of living tissues . aminoacids, monosaccharides, oligosaccharides, nucleotides, peptides.
- Nanoparticles
- Biomaterials

Unit II

1. Primary, Secondary, tertiary and quaternary structures of proteins, protein folding and denaturation
2. DNA & RNA: Double helical structure of DNA, Structure of RNA, role of RNA in gene expression
3. DNA replication, recombination and repair

Unit III

1. Basic concepts of metabolism: Coupled and interconnecting reactions of metabolism cellular energy resources and ATP synthesis
2. Glycolysis and Gluconeogenesis
3. Citric acid cycle
4. Oxidative phosphorylation : Protein and its regulation
5. Fatty acid metabolism: Synthesis and degradation of fatty acids (**alpha and beta oxidation**)

Unit IV

1. RNA synthesis and splicing
2. Biosynthesis of amino acids
3. Biosynthesis of nucleotides
4. Biosynthesis of membrane lipids and steroids and lipid storage
5. Protein synthesis

Unit V

1. Enzymes: Terminologies, classification and basics of enzyme kinetics
2. Mechanism of enzyme catalysis
3. Regulation of enzyme reaction
4. Concept of free energy and thermodynamic principals in biology
5. Energy rich bonds, compound and biological energy transducers

Suggested Reading Materials:

1. Voet, D. and J.G. Voet. Biochemistry John Wiley & Sons.
2. Freifelder, D. Physical Biochemistry W.H. Freeman & Co.
3. Segal, I.H. Biochemical calculations John Wiley and Sons
4. Creighton, T.E. Protein Structure and Molecular Properties W.H. Freeman & Co.
5. Freifelder, D. Essentials of Molecular Biology
6. Wilson, K. and K.H. Goulding A Biologists Guide to Principals and Techniques of Practical Biochemistry
7. Cooper, T.G. Tools of Biochemistry
8. Hawk, Practical Physiological Chemistry
9. Garret, R.H. and C.M. Grisham. Biochemistry. Saunders college Publishers

First Semester

PRACTICAL I
(Based on Paper I & II)

Practical Course

1. Identification and classification of various Slides and Specimens of
 - Invertebrate phyla (9 Phylum)
 - Minor phyla (Rotifera, Ectoprocta, Entoprocta and Phoronida)
 - Larval Forms (Cestoda, Crustacea, Mollusca and Echinodermata)
2. Study of Homology, Analogy and Modifications of Mouth Parts.
3. Calculation of Gene and Genotype Frequency in Population by Hardy Weinberg Law.
4. Major Dissection of Nervous system in Squilla , Loligo, Aplysia and Mytilus /Unio.
5. Minor Dissection
 - Mouth parts and Sting apparatus of Honey bee.
 - Aristotl lantern in Echinus
 - Reproductive organs in Grasshopper
6. Preparation of Permanent Mounting of Mouthparts / Gill /Septal Nephridia / Parapodia / Ovary .

Practical Scheme

Max.marks :-50 Min:-20

Time :- 4 hrs

Exercise	Marks Allotted
1. Major Dissection.....	08
2. Minor Dissection.....	05
3. Permanent Mounting.....	04
4. Spotting	14
5. Exercise based on Evolution (Homology, Analogy and Modifications of Mouth Parts).....	04
6. Problems related to Population Genetics.....	05
7. Viva.....	05
	45
8. Record.....	05

First Semester

PRACTICAL II
(Based on Paper III & IV)

Practical Course

1. Study of specimens or Models related to
 - Endangèred and Threatened species with their management.
India: Tiger, Lion, Crocodile, Rhinoceros
M.P.: Bird of Paradise (Doodhraaj), ~~Barasingha~~, Black Buck
 - Reptiles, Birds and Mammals: Endemic species & Local Fauna
2. Problem based on Biostatistics (Mean, Median, Mode, St. deviation, Chi square, Correlation)
3. Study of Wild life Sanctuaries and National Parks of M.P.
4. Visit to any ecological or wild life area & submission of visit report.
5. Assessment of Shannon- Weiner Diversity & Dominance Index of plants or insects within college campus.
6. Demonstration of Enzyme (Pepsin, Trypsin & Amylase) action and effect of PH & Temp.
7. Estimation of pH in a given sample.

Practical Scheme

Max.Marks :-50 Min:-20

Time :- 4 hrs

Exercise	Marks Allotted
1. Spotting.....	12
2. Problems in Biostatistics(any two).....	08
3. Exercise based on Wild life	05
4. Exercise based on Biodiversity Index.....	05
5. Demonstration of Enzyme action /Estimation of pH.....	05
6. Viva.....	05
	<hr/>
	40
7. Record + visit Report.....	10
	<hr/>
	Total Marks : 50

Handwritten signatures and dates:
Nandkumar 17/8/12
Shivaram 12-8-12
Mannan 17/8/12
Bhish 17/8/12
Ravi 17/8/12
Sankar 17/8/12

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M.Sc. Zoology
Second -Semester
Paper-I

GENERAL AND COMPARATIVE ANIMAL PHYSIOLOGY AND ENDOCRINOLOGY

Unit I

1. Respiratory pigments through different phylogenic groups
2. Transport of oxygen and carbon dioxide in blood and body fluids
3. Regulation of respiration
4. Physiology of impulse transmission through nerves and synapses
5. Autonomic nervous system, neurotransmitters and their physiological functions

Unit II

1. Patterns of nitrogen excretion in different animal groups
2. Comparative physiology of digestion
3. Osmoregulation in different animal groups
4. Thermoregulation in homeotherms, poikilotherms and hibernation
5. Physiology of pregnancy, placental hormones, pregnancy diagnosis tests, parturition and lactation, Seasonal breeders and Continuous breeders

Unit III

1. Comparative study of mechanoreception (lateral line system)
2. Comparative study of photoreception
3. Comparative study of phonoreception
4. Comparative study of chemoreception

Unit IV

1. Bioluminescence as means of communication among animals
2. Pheromones and other similar chemicals as means of communication among animals
3. Chromatophores and regulation of their function among animals
4. Hormones, their classification and chemical nature
5. Mechanism of hormone action

Unit .V

1. Vertebrate Endocrine System: Detail Structure and Function (pituitary, pancreas, adrenal, and thyroid gland)
2. Neuroendocrine system
3. Hormone receptors, signal transduction mechanisms

Suggested Reading Materials:

1. EJW Barrington-General & comparative Endocrinology-Oxford, Clarendon Press
2. R.H. Williams-Text Book of Endocrinology-W.B. Saunders
3. C.R. Martin- Endocrine Physiology-Oxford University Press.
4. Molecular CellBiology-J. Darnell, H. Lodish and D. Baltimore-Scientific American Book USA
5. Molecular Biology of the cell-B. Alberts, D-Bray, J.Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Pub. New York.

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M. Sc Zoology Second Semester Paper II Population Ecology and Environmental Physiology

Unit I

1. Populations and their characters.
2. Demography: Life tables, generation time, reproductive value.
3. Population growth: Growth of organisms with non-overlapping generations, stochastic and time lag models of population growth, stable age distribution.
4. Population Regulation: Extrinsic and Intrinsic mechanisms.

Unit II

1. Adaptations : Levels of adaptations, significance of body size.
2. Aquatic Environments: Fresh water, marine, shores and estuarine environments.
3. Eco-physiological adaptations to fresh water environments.
4. Eco-physiological adaptations to marine environments.
5. Eco-physiological adaptations to terrestrial environments.

Unit III

1. Environmental limiting factors.
2. Inter and intra-specific relationship.
3. Predatory- prey relationship, predator dynamics Mutualism, optimal foraging theory (patch choice, diet choice, prey selectivity, foraging time).

Unit IV

Acclimatization with the changing environment-

- Life in hot environment
- Life in cold environment
- Life at high altitude
- Life under high atmospheric pressure
- Aviation and space physiology

Unit V

1. Concept of homeostasis.
2. Endothermic and physiological mechanism of regulation of the body temperature.
3. Physiological response to oxygen deficient stress.
4. Physiological response to body exercise.
5. Meditation, yoga and their effects.

Suggested Reading Materials:

1. Cherrett, J.M. Ecological Concepts. Blackwell Science Publication, Oxford, U.K.
2. Elseth, B.D. and K.M. Baumgartner, population Biology, Van Nostrand Co., New York.
3. Jorgensen, S.E. Fundamentals of ecological modeling. Elsevier, New York.
4. Krebs, C.J. Ecology. Harper and Row, New York.
5. Krebs, C.J. Ecological Methodology. Harper and Row, New York.
6. Eckert, R. Animal Physiology: Mechanism and Adaptation. W.H. Freeman and Co., New York.
7. Hochachka, P.W. and G.N., Somero. Biochemical adaptation. Priceton, New Jersey.

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M. Sc Zoology
Second Semester
Paper III
Tools and Techniques in Biology

Unit I

1. Microscopy, principle & applications

- Light microscope and phase contrast microscope
- Electron microscope
- Fluorescence microscope
- Confocal microscope

2. General Principle and applications of

- Colorimeter
- Ultra centrifuge
- Beer and Lambert's law.
- Spectrophotometer
- Flame photometer

3. Microbiological techniques

- General idea of Media Preparation and sterilization
- Microbial identification (cytological staining methods for bacterial and fungal strains)
- Use of fermentors

Unit II

1. Computer aided techniques for data presentation, data analysis, statistical techniques.

2. Cryotechniques

- Cryopreservation of cells, tissues, organs and organisms.
- Cryosurgery
- Cryotomy
- Freeze fracture and freeze drying.

3. Separation techniques.

- Chromatography, principle, type and application.
- Electrophoresis, Principles, types and application. PAGE and Agarose Gel Electrophoresis.
- Organelle separation by centrifugation.

Suggested Reading Materials:

1. Introduction to instrumental analysis-Robert Braun-McGraw Hill.
2. A biologist Guide to principles and Techniques of Practical Biochemistry- K, Wilson and K.H. Goulding EIBS Edn.
3. Clark & Swizer. Experimental Biochemistry. Freeman, 2000.
4. Locquin and Langeron. Handbook of Microscopy. Butterwaths, 1983
5. Boyer. Modern Experimental Biochemistry. Benjamin, 1993
6. Freifelder. Physical Biochemistry. Freeman, 1982.
7. Wilson and Wlaker. Practical Biochemistry. Cambridge, 2000.
8. Cooper. The Cell-A Molecular Approach. ASM, 1997
9. John R.W. Masters. Animal Cell culture- A practical approach. IRL Press.
10. Robert Braun. Introduction to instrumental analysis. McGraw Hill

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M. Sc Zoology
Second Semester
Paper IV
Molecular Cell Biology and Genetics

Unit . I

Biomembrane

- Molecular composition arrangement and functional consequences
- Transport across cell membrane - diffusion, active transport, **membrane channels**, pumps, uniports, symports and antiports.
- Micro filaments and microtubules structure and dynamics
- Cell movements, intracellular transport - role of kinesin and dynein

Unit . II

Cell. Cell signaling

- Cell surface receptors
- Signaling from plasma membrane to nucleus and Integrins)
- Second messenger system
- Cell junctions (Gap junctions, connexins-

Unit III

Cell-Cell adhesion and communication

- **Cell matrix adhesion (collagen and non collagen components)**
- Ca⁺⁺ dependent homophilic cell - cell adhesion
- Ca⁺⁺ independent homophilic cell-cell adhesion
- Genome organization, hierarchy in organization
- Chromosomal organization of genes and non-coding DNA

Unit IV

Sex determination

- Sex determination in Drosophila
- Sex determination in mammals
- Basic concept of dosage compensation
- Cytogenetic of human chromosomes
- Human genome project (HGP)

Unit V

Genetic Diseases and Genomics

- Human gene therapy
- Genetic screening
- Functional Genomics
- Transgenic animals & their applications
- Prenatal diagnosis & genetic counseling
- Structural Genomics
- Gene libraries

Suggested Reading Materials:

- J. Darnell, H. Lodish and D. Baltimore molecular cell biology scientific American book. Inc. USA
- B. Alberts D. Bray, J. Lewis, M. raff, K. roberts and J.D. Wattson. molecular biology of the cell. Garland Publishing Inc. New York.
- John R. W. animal cell culture A practical approach masters. Irl. Press
- Alberts et. all Essentials cell biology garland publishing Inc. New York 1998
- J.M. Barry molecular biology
- Philip E. Hartman Gene Action
- L.C. dunn, principals of Genetics
- A.M. Winchester genetics
- Edgar Alterbrg Genetics
- L.C. Dunn Genetics and the origin of species
- Bengt A. Kihlman Actions of chemicals of dividing cells

M.Sc. Zoology

Semester - II

Practical –I

Paper I - General and comparative Physiology and endocrinology

Paper II - Population ecology and environmental physiology

1. Experiment on hematology: blood groups, Hb, total differential counts.
2. Demonstration of Osmosis in RBC.
3. Demonstration of ESR.
4. Preparation of Blood Report (Hb%, RBC Counts, Blood Group & ESR).
5. Estimation of pH.
6. Demonstration of Enzyme Action & Chromatography.
7. Demonstration of Blood Glucose (GOD & POD).
8. Colorimetric estimation of Protein (Biuret or Folin-Lowry Method).
9. Detection of nitrogenous products in given samples (Milk & Urine).
10. Endocrinological spots, comments on prepared histological slides.
11. Effect of posture, exercise and stress on blood pressure.
12. Impact of life style on lipid profile and management through yoga and physical exercises

SCHEME OF PRACTICAL EXAMINATION

S.No.	Name of the experiment	Marks
1.	Experiment based on Haematology .	10
2.	Demonstration of Enzyme Action & Chromatography.	10
3.	Demonstration of Blood Glucose.	05
4.	Detection of Nitrogenous products.	04
5.	Colorimetric Estimation of Protein.	05
6.	Spotting.	06
7.	Viva-voce	05
8.	Practical records & collection	05
	Total Marks	50

M.Sc. Zoology

Semester - II

Practical –II

Paper – III Tools and techniques for biology

Paper – IV Molecular cell biology and genetics

1. Comments upon the structure and application of analytical instruments
 - (a) Colorimeter
 - (b) Spectrophotometer
 - (c) Ultracentrifuge
 - (d) ESR and NMR spectrometer
 - (e) Microtome
 - (f) Biochemical Analyser
 - (g) PCR
2. Problems based on genetics- Pedigree analysis
3. Estimation techniques based for RNA and DNA Isolation.
4. Estimation of Chromosome polymorphism, isozyme polymorphism in some insect population. .
- 5.. Demonstration of Ag-Ab reaction by Oucferlony Method/ VDRL Test.
6. Demonstration of ELISA Technique.
7. Estimation of gene and genotype frequencies in light of Hardy- Weinberg Law based on facial traits.
8. Calculation of the rate of heart beat from recording provided.

SCHEME OF PRACTICAL EXAMINATION

S.No.	Name of the experiment	Marks
1.	Comments on Analytical Instruments.	10
2.	Problems based on genetics.	10
3.	Estimation techniques based for RNA and DNA Isolation.	05
4.	Estimation of gene and genotype frequencies in light of Hardy-Weinberg Law based on facial traits.	05
5.	Experiments based on immunology	10
6.	Viva-voce	05
8.	Practical Records	05
	Total Marks	50

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M.Sc. Zoology
Third Semester

Paper- I
Comparative Anatomy of Vertebrates

Unit-1

1. Origin of Chordata: Concept of Protochordata
2. **Systematic Classification of Chordates**
3. Development, structure and functions of integument and its derivatives (glands, scales, feathers and hairs)
4. Respiratory system: external and internal respiration. Comparative account of respiratory organs.

Unit-2.

1. Comparative account of Digestive System.
2. Evolution of heart.
3. Evolution of aortic arches and portal systems.
4. Blood circulation in various vertebrates groups.
5. Comparative account of jaw suspensorium and vertebral column.

Unit-3

1. Evolution of urinogenital system in vertebrates.
2. Comparative account of organs of olfactory and taste.
3. Comparative anatomy of brain and spinal cord (CNS).
4. Comparative account of peripheral and autonomous nervous system.

Unit-4

1. Comparative account of lateral line system.
2. Comparative account of electroreception.
3. Flight adaptations in vertebrates.
4. Aquatic adaptations in birds and mammals.

Unit-5

1. Origin, evolution, general organization and affinities of Ostracoderms.
2. General organization, specialized, generalized and degenerated characters of Cyclostomes.
3. Origin, evolution, general organization of early Gnathostomes .
4. General account of Elasmobranchi, Holocephali, Dipnoi and Crossoptergii.

Suggested Reading Materials:

1. Carter, G.S. Structure and habit in vertebrate evolution – Sedgwick and Jackson, London.
2. Kingsley, J.S. Outlines of Comparative Anatomy of Vertebrates, Central Book Depot, Allahabad,
3. Kent, C.G. Comparative anatomy of vertebrates
4. Malcom Jollie, Chordata morphology. East – West Pres Pvt. Ltd., New Delhi.
5. Milton I lildergrand. Analysis of vertebrate structure. IV. Ed. John Wiley and Sons Inc., New York.
6. Smith, H.S. Evolution of Chordata structure. Hold Rinchart and Winstoin Inc. New York.
7. Sedgwick, A.A. Students Text Book of Zoology, Vol.II.
8. Walter, H.E. and Sayles, L.D. Biology of vertebrates, MacMillan & Co. New York.
9. Romer, A.S. Vertebrate Body, IIIrd Ed. W.B. Saunders Co., Philadelphia
10. Young J.Z. life of vertebrates. The oxford University Press, London
11. Parker & Haswell to III Rev. by Marshall willians latested Macmillan Co. ltd.
12. Young J.Z. Life of mammals. The Oxford University Press, London
13. Weichert, C.K. and Presch, W. Elements of chordate anatomy, 4th Edn. McGraw Hall Book Co., New York.

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M.Sc. Zoology
Third semester
Paper- II
Limnology

Unit-1

- 1.Limnology** – Definition, historical development and scope of Limnology.
- 2.Types of freshwater habitats and their ecosystem -**
(a) Ponds, Streams and rivers. (b) Lakes – Origin and classification.
- 3.Morphometry** – Use of various morphometric parameters and Zonation.

Unit-2

Physico – Chemical Characteristics.

1. Light and Temperature-

- (a) Light as an ecological parameter in freshwater.
- (b) Temperature- Radiation, Stratification and Heat Budget.

2. Dissolved Solids – Carbonate, Bicarbonates, Phosphate and Nitrate.

-Physico – Chemical characteristics of freshwater with special reference to different parameters-Turbidity, dissolved gases (Oxygen, Carbon dioxide, Hydrogen Sulphide),
-Seasonal changes in dissolved gases and pH.

Unit-3

1. Study of Biota

- (a) Phytoplankton, Zooplankton and their inter-relationship.
- (b) Aquatic insects, birds and their environmental significance.

2. Ecological classification of aquatic fauna higher aquatic plants and their significance.

Unit-4

1. Methods of water quality testing BOD and COD.

2. Sewage – Definition, composition and its treatment.

3. Bioindicators- Aquatic flora and fauna in relation to water quality in an aquatic environment.

Unit-5

1. Causes of pollution of Aquatic Resources, their management and conservation.

2. Resource Conservation – Aquatic pollution, control, legislation, regulation on discharge of industrial effluents and domestic wastes in rivers and reservoirs.

3. Use and misuse of inland waterways of India.

Suggested Reading Materials:

Anathakrishnan : Bioresources Ecology

Goldman : Limnology

Odum : Ecology

Pawlosuske : Physico- chemical methods for water

Wetzel : Limnology

Trivedi & Goyal : Chemical and biological methods for water pollution studies Welch :

Limnology Vols. I-II, Perkins : Ecology, Arora : Fundamentals of environmental biology.

M. Sc. Zoology 2015-2016 Onwards
Department of Higher Education, Govt. of M.P.
Semester wise Syllabus for Postgraduates

**As recommended by Central board of Studies and
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M.Sc. Zoology
Third Semester
Paper- III

ECO- TOXICOLOGY

Unit-1

1. General principles of Environmental Biology with emphasis on ecosystems.
2. Abiotic and biotic factors of ecosystems.
3. Communities of the environment, their structure & significance.
4. Energy flow in environment: Ecological energetic.

Unit-2

1. Productivity, Production and analysis.
2. Recycling and reuse technologies for solid and liquid wastes and their role in environmental conservation.
3. Remote sensing –basic concepts and applications of remote sensing techniques in environmental conservation.
4. Environmental indicators and their role in environmental balance.

Unit-3

1. Kinds of environmental pollution and their control methods.
2. Radioactive compounds and their impact on the environment.
3. Vehicular exhaust pollution causes and remedies.
4. Noise pollution.

Unit-4

1. Toxicology- Basic concepts, Principles and various types of toxicological agents.
2. Toxicity testing principles, hazards, risks and their control methods.
3. Food toxicants and their control methods.
4. Public Health Hazards due to environmental disasters.

Unit-5

1. Pesticides, types, nature and their effects on environment.
2. Important heavy metals and their role in environment.
3. **Agricultural pest and their bio-control.**
4. Occupational Health Hazards and their Control.

Suggested Reading Materials:

1. Clark : Elements of ecology
2. Odum : Fundamentals of Ecology
3. South Woods : Ecological methods
4. Trivedi and Goel : Chemical and biological methods for water pollution studies

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Semester wise Syllabus for Postgraduates

**As recommended by Central board of Studies and
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M. Sc. Zoology
Third Semester
Paper- IV
Aquaculture

Unit-1

1. Aquaculture: history, definition, scope & importance.
2. Fishery resources of India in general & Madhya Pradesh in particular.
3. Abiotic & biotic factors of water necessary for fish life.
4. Ecological characteristics of lakes & rivers.
5. General ecological characteristics of reservoirs of India.

Unit-2

1. Fish culture :- Mono, Poly, mixed and composite Fish culture.
2. Fresh water prawn culture and its prospects in India.
3. Culture of Mussels, clams, oysters & pearl culture.
4. Sewage fed fish culture, paddy cum fish culture
5. Frog culture.

Unit-3

1. Fish breeding in natural conditions, bundh breeding, hypophysation & stripping.
2. Transport of live fish & seed.
3. Different types of crafts & gears used for fish catching.
4. Plankton- its definition, culture & identification.
5. Common weeds of fish ponds and methods of their eradication.

Unit-4

1. Fresh water fish farm engineering:
 - selection of site, -construction of fish farm & soil chemistry.
 - Designing, layout & construction of different types of fish ponds.
2. Setting and management of fresh water aquarium.
3. Preservation & processing of fish.
4. By-products of fish Industry & their utility.

Unit-5

1. Water pollution, its effects on fisheries and methods of its abatement.
2. Common fish diseases & their control.
3. Biochemical composition and nutritional value of fish.
4. Fisheries economics and marketing.
5. Fisheries managements and extension.

Suggested Reading Materials:

1. C.B.L. Shrivastava : Fishes of India
2. Jhingaran : Fish and fisheries of India
3. S.S. Khanna : An Introduction to fishes
4. R.S. Rath : Fresh water Aquaculture
5. Gopalji Shrivastava : Fishes of U.P. & Bihar
6. H.D. Kumar : Sustainibility & Management of Aquaculture & Fisheries
7. A.J.K. Mainan : Identification of fishes
8. R. Sanatam : A Manual of fresh water Aquaculture
9. S.K. Gupta : Fish & Fisheries
10. P.D. Pandey : Fish & Fisheries
11. K.P. Vishwas : Fish & Fisheries

**Department of Higher Education,
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Post Graduate Semester wise
Syllabus
As recommended by Central Board of Studies and approved
by the Governor of M.P.
Subject - Zoology
Class -M.Sc
Semester - III**

Subject - Zoology
Practical I: Related to I & II Theory Papers

1. Study of Specimens, slides and bones related to theory papers.
2. Major Dissection- General anatomy of cranial nerves of Labeo , Wallago.
3. Minor Dissection-Accessory respiratory organs of Clarias, Heteropneustes.
4. Estimation of DO, chloride, BOD, COD,Hardness, pH and Alkalinity of water.
5. Study of fresh water ecosystem.

Scheme for Practical Examination M.M. 50

1. Major Dissection	10 Marks
2. Minor Dissection	04 Marks
3. Spotting	12 Marks
4. Limnological exercise	10 Marks
5. Practical Record	05 Marks
6. Viva Voce	05 Marks
7. Collection	04 Marks

Total **50 Marks**

Department of Higher Education,
Govt. of M.P.
Post Graduate Semester wise
Syllabus
As recommended by Central Board of Studies and approved
by the Governor of M.P.
Subject - Zoology

Class - M.Sc
Semester -III
Subject - Zoology
Practical II : Related to III & IV Theory Papers

1. Study of plankton.
2. Preparation and Maintenance of Aquarium.
3. Formulation and preparation of artificial fish feed.
4. Study of common weeds of fish ponds.
5. Methods of culture related to theory papers.
6. Study of abiotic factors of water related to fish life.
7. Determination of different toxic chemicals in samples of soil, water and air.
8. Toxicological testing methods, General tests, acute toxicity test and LD **50** test.
9. Visit to freshwater/marine fish farm
10. Identification and comments on Aquaculture animals.
 1. Prawn
 2. Oyster
 3. Frog
 4. Clam
 5. Pearl
 6. Aquarium fishes
 7. Labeo rohita
 8. Labeo calbasu
 9. Catla
 10. Mahaseer
 11. Mystis
 12. Wallago

Scheme of Practical Examination

M.M. 50

- | | |
|---|----|
| 1. Spotting | 16 |
| 2. Exercise on toxicology | 05 |
| 3. Study of culture methods related to theory | 05 |

4. Maintenance of aquarium and feed formulation	10
5 Visit Report	05
5. Practical Record/ Collection	05
6. Viva Voce	04

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Semester wise Syllabus for Postgraduates

**As recommended by Central board of Studies and
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Class : M.Sc.

Semester : IV

Title of Subject/ Group : ANIMAL BEHAVIOUR AND NEUROPHYSIOLOGY

Paper No. : I

Compulsory/ Optional : Compulsory

Unit- 1

Introduction:

- Ethology as a branch of biology.
- Animal psychology, classification of behavioral patterns, analysis of behaviour (ethogram)
- 2. Reflexes and complex behaviour.
- 3. Perception of the environment: mechanical, electrical, chemical, olfactory, auditory and visual.
- 4. Evolution and ultimate causation: Inheritance behaviour and relationships.

Unit- 2

1. Neural and hormonal control of behaviour.
2. Genetic and environmental components in the development of behaviour.
3. Motivation: Drive, timing and interaction of drives, physiological basis of motivation, hormones and motivation, aggregation.
4. Communication: Chemical, visual, light and audio, evolution of language (primates).
5. Bioluminescence and colouration in fishes.

Unit- 3

1. Ecological aspects of behaviour: Habitat selection, food selection, optimal foraging theory, anti-predator, defenses, aggression, homing territoriality, dispersal, host-parasite relations.
2. Biological rhythms: Circadian and Circannual rhythms, orientation and navigation, migration of fishes, turtles and birds.
3. Learning and memory: Conditioning, habituation, insight learning, association learning and reasoning.

Unit- 4

1. Reproductive behaviour. Evolution of sex and reproductive strategies, mating systems, courtship, sexual selection. parental care in fishes.
2. Social behaviour. aggregations, schooling in fishes, flocking in birds, herding in mammals, group selection,

3. Kin selection, altruism, reciprocal altruism, inclusive fitness,
4. Social organization in insects and primates.

Unit- 5

1. Human Ethology – Ethological concept of and human behavior
 - Concept of sign stimuli
 - Concept of imprinting
 - Kinship of human social systems
 - Human pheromones
2. Territorial behavior and bird song
3. Aggressive behavior.
4. Altruism

Suggested Readings -

1. Eibl-Eibesfeldt, I. Ethology. The biology of Behaviour. Holt, Rinehart & Winston, New York.
2. Gould, J.L. The mechanism and Evolution of Behaviour.
3. Kerbs, J.R. and N.B. davies : Behaviourable Ecology. Blackwell, Oxford, U.K.
4. Hinde, R.A. Animal Behaviour : A Synthesis of Ethology and Comparative Psychology. McGraw Hill, New York.
5. Alcock, J. Animal Behaviour : An Evolutionary approach. Sinauer Assoc. Sunderland, Massachsets, USA.
6. Bradbury, J.W. and S.L. Vehrencamp. Principles of Animal Communication. Sinauer Assoc. Sunderland, Massachsets, USA.

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Semester wise Syllabus for Postgraduates

**As recommended by Central board of Studies and
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Class : M.Sc.

Semester : IV

Title of Subject/ Group : Gamete Biology, Development and Differentiation

Paper No. : II

Compulsory/ Optional: Compulsory

Unit- 1

- 1.Methods of differentiation of gonads in mammals and its genetic basis
2. Spermatogenesis - morphological basis in rodents
- 3.Gamete specific gene expression and genomics, Vertebrates morphology : Definition, scope and importance.
- 4.Biochemistry of semen, semen composition and formation , assessment of sperm function
- 5.Fertilization- Prefertilization events , biochemistry of fertilization Post fertilization events

Unit- 2

1. Ovarian follicular growth and differentiation morphology endocrinology, molecular biology of oogenesis and vitellogenesis ovulation and ovum transport in mammals
- 2.Biology of sex determination and sex differentiation in mammals
- 3.Multiple ovulation and embryo transfer technology, in-vitro oocyte maturation, super ovulation
- 4.Elementary idea of IVF

Unit- 3

1. Hormonal regulation of ovulation, pregnancy and parturition.
2. Hormonal regulation of development of mammary gland and lactation.
3. Endocrinology and Physiology of placenta.
4. Cryopreservation of Gametes and Embryo.
- 5.Teratological effects of xenobiotics on gametes

Unit- 4

1. Cell commitment and differentiation.
2. Germ cell determinants and germ cell migration.
3. Types of Morphogenetic movements in frog.

4. Early development of fish
5. Concept of totipotency and pleuripotency, competence and induction, primary and secondary inducers wsr to neurulation and neural induction
6. Melanogenesis.

Unit- 5

1. Stem cell concept- embryonic and adult stem cell
2. Adult stem cell niches mesenchymal stem cells
3. Epidermal stem cell culture
4. Haemopoietic stem cells: Blood cells formation.
5. Use of Stem cell in disorders.
6. Connective tissue cell family.

Suggested Readings:

1. Carter, G.S. Structure and habit in vertebrate evolution – Sedgwick and Jackson, London.
2. Kingsley, J.S. Outlines of Comparative Autonomy of Vertebrates, Central Book Depot. Allahabad,
3. Kent, C.G. Comparative anatomy of vertebrates
4. Malcom Jollie, Chordata morphology. East – West Pres Pvt. Ltd., New Delhi.
5. Milton I lildergrand. Analysis of vertebrate structure. IV. Ed. John Wiley and Sons Inc., New York.
6. Smith, H.S. Evolution of Chordata structure. Hold Rinchart and Winstoin Inc. New York.
7. Sedgwick, A.A. Students Text Book of Zoology, Vol.II.
8. Walter, H.E. and Sayles, L.D. Biology of vertebrates, MacMillan & Co. New York.
9. Romer, A.S. Vertebrate Body, IIIrd Ed. W.B. Saunders Co., Philadelphia
10. Young J.Z. life of vertebrates. The oxford University Press, London
11. Parker & Haswell to III Rev. by Marshall willians latested Macmillan Co. ltd.
12. Young J.Z. Life of mammals. The Oxford University Press, London
13. Weichert, C.K. and Presch, W. Elements of chordate anatomy,
13. Long J.A. Evan H.M. 1922 : the oestrous cycle in the Rat and its associated phenomenon.
14. Nalbandou. A.C. – Reproductive physiology
15. Prakash A.S. 1965-66 Marshall's, Physiology Reproduction (3 Vol.)
16. Ethan Bier, the cold Spring. The cold spring Harbor laboratory Press, New York.
17. Davidson, E.H. Gene Activity During Early Development. Academic Press, New York.

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Department of Higher education, Govt. of M.P.
Semester wise Syllabus for Postgraduates

**As recommended by Central board of Studies and
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Class : M.Sc

Semester : IV

Title of Subject/ Group : Cell Biology

Paper No. : III (b)

Compulsory/ Optional : Optional

Unit- 1

1. Molecular organization of eukaryotic chromosomes : structure of nucleosome particles and higher order compaction of mitotic chromosomes, chromatin remodelling
2. Specialized chromosomes I: structural organization and functional significance of polytene chromosomes
3. DNA methylation and DNA Aase-1 Hypersensitivity in relation to gene activity and chromatin organization.
4. Specialized chromosomes II : structural organization and functional significance of lampbrush chromosome.
5. Organisation and significance of heterochromatin.

Unit- 2

1. Structural organization of Eukaryotic genes, interrupted genes and overlapping genes and their evolution
 2. Gene families: organization, evolution and significance
 3. Transposable genetic elements of prokaryotes and eukaryotes
- Gene imitation and molecular mechanism of occurrence of mutation repair mechanism

Unit- 3

1. Organisation of eukaryotic transcriptional machinery promoter enhancers transcription factors polymerase activators and repressors.
2. DNA binding domains of transcription apparatus zinc finger steroid receptors hemeo domains HILIX-loop, Helix and Leucine Zipper.
3. Eukaryotic transcription of Eukaryotic transcriptional control.
4. Environmental modulation of gene activity (stress response) stress genes and stress proteins
5. Molecular basis of thalasemias muscular dystrophy cystic fibrosis

Unit- 4

1. DNA rearrangement
2. Amplification during development with special response to
(a) Ciliates (b) Chlorine gene (c) 58 RNA genes
3. Drosophila development

(a) Cleavage

(b) Gastrulation

Origin of Anterior –Posterior (Maternal effect genes and segmentation genes)

Unit- 5

1. Drosophila development II origin of dorsal ventral polarity
2. Basic idea of homeotic selector genes and homeotic mutation
3. Basic idea of organization of homeoboxes
4. Evolutionary significance of homeoboxes

Reference of Books:

1. Robertis, De and Robertis Cell and molecular biology Lea and Febiger.
2. Watson Hopkins Roberts Steitz Weiner, Molecular Biology of the Gene the Benjamin, Cummings Publishing Company inc.
3. Bruce A; Bertz Bray Lewis Raff Roberts Watson Molecular Biology of the Cell, Garland Publishing inc.
4. Watson Gilman Witkowski Zoller Recombinant DNA Scientific American Books.
 - a) Karp Gerald Cell Biology.
 - b) Lewin B., Genes VII.
 - c) King Cell Biology.
 - d) Kaniel L. Hartl, Elizabeth W. Jones. Genetics Principles and Analysis, Jones and Bartlett Publishers.
5. Kuby, Immunology, W.H. Freeman and Company.
6. Roitt Male Snustad Immunology.

Department of Higher Education, Govt. of M.P.
Semester wise Syllabus for Postgraduates

As recommended by Central board of Studies and
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Class : M.Sc.

Semester : IV

Title of Subject/ Group : Wild Life Conservation

Paper No. : III (d)

Compulsory/ Optional : Optional

Unit- 1

1. Wild life -

- (a) Values of wild life - positive and negative.
- (b) Our conservation ethics.
- (c) Importance of conservation.
- (d) Causes of depletion.
- (e) World conservation strategies.

2. Habitat analysis, Evaluation and Management of wild life.

- (a) Physical parameters - Topography, Geology, Soil and water.
- (b) Biological Parameters - food, cover, forage, browse and cover estimation.
- (c) Standard evaluation procedures - remote sensing and GIS.

3. Management of habitats -

- (a) Setting back succession.
- (b) Grazing logging.
- (c) Mechanical treatment.
- (d) Advancing the successional process.
- (e) Cover construction.
- (f) Preservation of general genetic diversity.

Unit- 2

1. Population estimation.

- (a) Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation.
- (b) Faecal analysis of ungulates and carnivores - Faecal samples, slide preparation, Hair identification, Pug marks and census method.

2. National Organization.

- (a) Indian board of wild life.
- (b) Bombay Natural History Society.
- (c) Voluntary organization involved in wild life conservation.

3. Wild life Legislation - Wild Protection act - 1972, its amendments and implementation.

Unit- 3

- 1. Management planning of wild life in protected areas.
- 2. Estimation of carrying capacity.

3. Eco tourism / wild life tourism in forests.
4. Concept of climax persistence.
5. Ecology of perturbence.

Unit- 4

1. Management of excess population & translocation.
2. Bio- telemetry.
3. Care of injured and diseased animal.
4. Quarantine.
5. Common diseases of wild animal.

Unit- 5

1. Protected areas National parks & sanctuaries, Community reserve.
2. Important features of protected areas in India.
3. Tiger conservation - Tiger reserve in M.P, in India.
4. Management challenges in Tiger reserve.

Suggested Readings:

1. Gopal Rajesh : Fundamentals of wild life management
2. Agrawal K.C : Wild life India
3. Dwivedi A.P (2008) : Management wild life in India
4. Asthana D.K : Envionment problem and solution
5. Rodgers N.A & Panwar H.S : Planning of wild life / Protected area Network in India]
vol. the report, wild life Institute of India Dehradun.
6. Odum E.P : Fundamentals of Ecology
7. Saharia V.B : Wild life in India
8. Tiwari S.K : Wild life in Central India
9. E.P Gee : Wild life of India
10. Negi S.S : Wild life conservation (Natraj Publishers)

M. Sc. Zoology 2015-2016 Onwards

**Department of Higher Education, Govt. of M.P.
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As recommended by Central board of Studies and

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Class : M. Sc

Semester : IV

Title of Subject/ Group : Cellular Organization and Molecular Organization.

Paper No. : IV (b)

Compulsory/ Optional : Optional

Unit- 1

1. General organization and characterizes of viruses (Examples SV 40 and HIV).
2. Yeast : Structure, reproduction and chromosome organization: Basic ideas of its applications as vectors for gene cloning.
3. Molecular organization of respiratory chain assemblies, ATP / ADP Translocase and F₀F₁ ATPase.
4. Cell cycle: Cell cycle control in mammalian cells and xenopus.

Unit- 2

1. Cytochemistry of Golgin complex and its role in cell secretion.,
2. Peroxisomes and training of paroxysmal proteins.
3. Nucleolus : Structure and Biogenesis and functions of lysosomes.
4. Intracellular digestion : Ultrastructure and function of lysosomes.

Unit- 3

1. Synthesis and targeting of mitochondrial proteins.
2. Secretary pathways and translocation of secretary proteins across the EPR membrane.
3. Genome complexity: C- value [Paradox and Cot value].
4. DNA sequences of different complexity.

Unit- 4

1. Difference between normal cells and cancer cells.
 - a. Biochemical changes.
 - b. Cytoskeleton changes.
 - c. Cell surface changes.
2. Genetic basis of human cancer.
3. Chromosomal abnormalities in human cancer.

Unit- 5

1. General idea of oncogenes and proto oncogenes.
2. Oncogene and cancer.
3. Transforming Agents.
4. Tumor Suppressor genes.
5. Receptor – Ligand interaction and signal transduction.
6. Cross – talk among various signaling pathways.

Reference of Book:

1. DeRobertis and De Robertis Cell and Molecular Biology. Lea and Febiger.
2. We Watson Hopking reberts steits, Weiner molecular biology of the gene, the Benjamin / Cummings Publishin Company Inc.
3. Bruce alberts, Bray, Lewis, Raff, Roberts, Watson molecular Biology of the cell garland publishing inc.
4. P.K. Gupta, Molecular Cell Biology Rastogi Publication.
5. Watson Gilman Witkowski, Zoller Recomdinant D.N.A. scientific American Books.
6. Gerald Karp. Cell Biology.

7. Lewin B. Genes VII.
8. King Cell Biology.
9. Baniel L. HArtl Elizabeth W. Jones, Genetics Principles and analysis . Jones and Bartlett Publisher.
- 10.Lodish, Berk Zipursky, Matsudaira Baltimore Dernel Molecular Cell Biology W.H. Freeman and company.
11. J. Travers Immunology current Biology limited.
12. Kubey Immunology W.H. Freeman and Company.
13. Riott, Male snustad Principles of genetics john weley and sons Inc.

**Department of Higher Education, Govt. of M.P. Post Graduate Semester wise
Syllabus as recommended by Central Board of Studies and approved by the
Governor of M.P.**

**Class M.Sc. Semester IV
Paper IV(d) (Optional)**

Environment & Biodiversity Conservation

Unit I

Basic concept of Environmental Biology

- Scope and Environmental Science
- Biosphere and Biogeochemical cycles.
- Environmental monitoring and impact assessment.
- Environmental and sustainable development.
- Water conservation, rain water harvesting, water shed management.

Unit II

- Cause, effects and remedial measure of Air pollution, Water pollution.
- Noise. Radioactive and Thermal pollution.
- Agriculture pollution
- Basic concepts of Bioaccumulation.
- Solid waste management.

Unit III

Global warming and disaster management

- Cause of global warming
- Impact of global warming – acid rains and ozone depletion, green house effect.
- Control measures of global warming
(a)Afforestation (b) Reduction in the use of CFCS
- Disaster management -floods, earthquake, Cyclones landslides.
- Environmental legislation.

Unit IV

Natural Resources :-

Forest

- Use and over exploitation of forests.
- Timber extraction.

Land

- Land degradation. Landslides.
- Soil-erosion and desertification.

Water

- Use and over utilization of surface and ground water
- Floods. Drought dams- benefits and problems

Mineral

- Use and exploitation ,
- Environmental effect of extracting and using mineral resources

Food

- World food problem
- Effects of modern agriculture and overgrazing

Energy

- Conventional and non-conventional energy resources.
- Using of alternate energy sources
- Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable life

Unit V

- Conservation of Biodiversity
- Biodiversity crisis – habitat degradation, poaching of wild life.
- Socio economic and political causes of loss of biodiversity.
- In situ and ex-situ conservation of biodiversity
- Value of biodiversity.
- Hot spots of Biodiversity.